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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/779,582	02/12/2004	James G. Couillard	SP03-018	8926

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CORNING INCORPORATED
SP-TI-3-1
CORNING, NY 14831

EXAMINER	
SARKAR, ASOK K	

ART UNIT	PAPER NUMBER
2891	

DATE MAILED: 07/25/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	10/779,582	COUILLARD ET AL.	
	Examiner	Art Unit	
	Asok K. Sarkar	2891	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 22 May 2006.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 66-99 and 102-136 is/are pending in the application.

4a) Of the above claim(s) 66-96 and 113-128 is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 97-99,102-112 and 129-136 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 07 July 2004 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date 5/9/06.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

3. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

4. Claims 97 – 99, 102, 104, 105,106 – 111, 112, 129 – 134 and 136 are rejected under 35 U.S.C. 103(a) as being unpatentable over Henley, US 6,010,579 in view of

Stewart, US 6,610,582; Spangler, US 5,343,064; Walker, US 6,825,909 and "Resistivity of Glass", http://hypertextbook.com/facts/2004/JaneGolubovskaya.shtml.

Regarding claims 97, 98, 108 – 110, 112, 129 and 133, Henley teaches a semiconductor – on – insulator layered structure comprising a substantially single – crystal semiconductor material (material S) (silicon wafer) and an oxide glass or an oxide glass-ceramic which comprises positive sodium ions (material G), wherein at least a part of the structure comprises in order:

- layer of material S, 2404; and
- layer of material G 2201, wherein the surface of material S, 2404 farthest from material G 2201 is an exfoliation surface with reference to **Fig. 12** and descriptions in between column 9, line 40 and column 13, line 15.

Henley teaches glass as a target wafer (column 10, line 64) and an electrostatic bonding process (column 11, lines 35 – 40) by applying voltage in column 13, lines 7 – 15 for the benefit of bonding two surfaces at a low temperature in column 11, lines 35 – 40. However, Henley <u>fails</u> to teach the consequences of the electrostatic bonding and the properties of the glass such as

- **(element 1)** layer of material S with an enhanced oxygen content due to attachment of non – bridging oxygen atoms; layer of material G with a reduced positive ion concentration for at least one type of positive ion due to depletion of mobile sodium ions; material G with an enhanced positive ion concentration for at least one type of positive ion due to the migration away from the interface; and the material S and material S with an enhanced oxygen content is a first layer;

the material G with a reduced positive ion concentration for at least one type of positive ion, the material G with an enhanced positive ion concentration for at least one type of positive ion, and the material G is a second layer; and the first and second layers are directly attached to one another as the final bonded structure.

- **(element 2)** oxide glass or oxide glass-ceramic has a 0 – 300°C coefficient of thermal expansion CTE and
- **(element 3)** a 250°C resistivity ρ which satisfy the relationships: 5 X 10-7/°C <= CTE <= 75 X 10^{-7}/°C and ρ < =10 ^{16} Ω – cm.
- **(element 4)** said oxide glass or oxide glass – ceramic having a strain point of less than 1000°C.

Regarding **element 1**, Stewart teaches electrostatic bonding between a sodium – containing glass and a silicon wafer in which layer of material S with an enhanced oxygen content due to attachment of non – bridging oxygen atoms; layer of material G with a reduced positive ion concentration for at least one type of positive ion due to depletion of mobile sodium ions; material G with an enhanced positive ion concentration for at least one type of positive ion due to the migration away from the interface; and the material S and material S with an enhanced oxygen content is a first layer; the material G with a reduced positive ion concentration for at least one type of positive ion, the material G with an enhanced positive ion concentration for at least one type of positive ion, and the material G is a second layer; and the first and second layers are directly

attached to one another as the final bonded structure in column 1, lines 30 – 43 as a consequence of the electrostatic bonding process.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention that Henley's bonded structure between a sodium – containing glass and a silicon wafer will have material S with an enhanced oxygen content due to attachment of non – bridging oxygen atoms; layer of material G with a reduced positive ion concentration for at least one type of positive ion due to depletion of mobile sodium ions; material G with an enhanced positive ion concentration for at least one type of positive ion due to the migration away from the interface; and the material S and material S with an enhanced oxygen content is a first layer; the material G with a reduced positive ion concentration for at least one type of positive ion, the material G with an enhanced positive ion concentration for at least one type of positive ion, and the material G is a second layer; and the first and second layers are directly attached to one another as the final bonded structure as a consequence of the electrostatic bonding as taught by Stewart in column 1, lines 30 – 43.

Regarding **element 2**, Stewart, Spangler and Walker teach that for making SOI structures with glass or bonding a glass with silicon, the coefficient of thermal expansion of the glass should be matched with that of silicon. Walker teaches that one such oxide glass has a 0 – 300^{O}C coefficient of thermal expansion of around 37.6 X $10^{-7}/^{O}$C.

Regarding **element 3**, "Resistivity of Glass", http://hypertextbook.com/facts/ 2004/JaneGolubovskaya.shtml. teaches that glasses have resistivity values that are < =10^{16} Ω – cm.

Therefore, (regarding elements 2 and 3) it would have been obvious to one with ordinary skill in the art at the time of the invention that an alkali containing glass that can be bonded to silicon will satisfy the following relationship:

$5 \text{ X } 10^{-7}/^{o}C <= CTE <= 75 \text{ X } 10^{-7}/^{o}C$ and $\rho < =10^{16}\ \Omega - \text{cm}$.

Regarding **element 4**, Spangler also teaches that the strain point of an alkali containing glass (similar to anneal point) is less than 1000°C in column 15, lines 1 – 5.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention that an alkali containing glass that can be bonded to silicon will have a strain point less than 1000°C as taught by Spangler in column 15, lines 1 – 5.

Regarding claim 99, Henley in view of Stewart teaches anodic or electrostatic bonding of alkali glass, but <u>fails</u> to teach glass wherein the at least one type of positive ion comprises an alkaline-earth ion.

Spangler teaches forming SOI structures by the same anodic bonding process in which the insulating glass is alkaline – earth glass in between column 14, line 64 and column 15, line 23 for the benefit of forming fully integrated SOI sensors in column 5, lines 1 – 13.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to modify Henley in view of Stewart and use a glass wherein the at least one type of positive ion comprises an alkaline-earth ion for the benefit of forming fully integrated SOI sensors as taught by Spangler in column 5, lines 1 – 13.

Regarding claim 102, Henley in view of Stewart <u>fails</u> to teach the thickness of the semiconductor material.

However, it would have been obvious to one with ordinary skill in the art at the time of the invention to judiciously adjust and control these parameters during the creation of SOI wafers between silicon wafer and glass by the anodic bonding and subsequent thinning process through routine experimentation and optimization to achieve optimum benefits (see MPEP 2144.05) and it would not yield any unexpected results.

Note that the specification contains no disclosure of either the critical nature of the claimed processes or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen methods or upon another variable recited in a claim, the Applicant must show that the chosen methods or variables are critical (*Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir., 1990)). See also *In re Aller, Lacey and Hall* (10 USPQ 233 – 237).

Regarding claims 104 and 105, Henley in view of Stewart <u>fails</u> to teach the maximum dimension of S material layer and the total concentration of the alkali ions such as Li^+, Na^+ and K^+ ions.

Spangler teaches forming SOI structures by the same anodic bonding process in which he teaches forming a full sensor device on a single wafer in column 4, lines 61 – 68 and that alkali ion contamination is unwanted for semiconductor manufacturing and ways to prevent it in between columns 3 and 4 and specifically uses a special glass that is free of alkali ions in between column 14, line 64 and column 15, line 23 for the benefit of forming fully integrated SOI sensors in column 5, lines 1 – 13.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to modify Henley in view of Stewart and use a glass wherein the glass is alkali ions free so that the total alkali ion concentration is less than 0.1wt% for the benefit of forming fully integrated SOI sensors as taught by Spangler in column 5, lines 1 – 13. Moreover, with the thermal expansion matching, it would have been obvious to one with ordinary skill in the art at the time of the invention to implement the bonding process to silicon wafers that has maximum dimensions greater than 10cm.

Regarding claim 106, Henley in view of Stewart <u>fails</u> to teach the oxide glass is transparent.

However, it would have been obvious to one with ordinary skill in the art at the time of the invention that the glass is transparent since most ordinary alkali silicate glasses are inherently transparent.

Regarding claim 107, Stewart <u>fails</u> to teach that the SOI structure comprises an amorphous or polycrystalline semiconductor material and SiGe.

However, it would have been obvious to one with ordinary skill in the art at the time of the invention that since the bonding is between silicon and glass, the semiconductor material can alternatively be amorphous or polycrystalline semiconductor material or SiGe material.

Regarding claim 111, Henley in view of Stewart <u>fails</u> to teach the relationship: $CTE_1 - 20 X 10^{-7}/oC <= CTE_2 <= CTE_1 + 20 X 10^{-7}/oC$ where CTE_1 is the $0^{O}C$ coefficient of thermal expansion of a single crystal semiconductor material and CTE_2 is the $0 - 300^{O}C$ coefficient of thermal expansion oxide glass or oxide glass-ceramic.

As was described earlier in rejecting claim 97, Spangler teaches thermal expansion of the glass that can be anodically bonded with the silicon should have a coefficient of thermal expansion of the glass should be matched with that of silicon. Walker teaches that one such oxide glass has a 0 – 300^{O}C coefficient of thermal expansion of around 37.6 X $10^{-7}/^{O}$C.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention that an alkali containing glass that can be bonded to silicon will have a relationship: CTE_1 – 20 X 10-7/oC <= CTE_2 <= CTE_1 + 20 X 10-7/oC where CTE_1 is the 0^{O}C coefficient of thermal expansion of a single crystal semiconductor material and CTE_2 is the 0 – 300^{O}C coefficient of thermal expansion oxide glass or oxide glass-ceramic.

Regarding claims 130 – 132 and 134, Henley in view of Stewart teaches the SOI structure where the semiconductor material has an enhanced oxygen content layer, the glass has a depleted as well as an enhanced positive ion material layer and these layers are created by the diffusion of positive ions under the voltage applied by the two electrodes during the anodic bonding process.

However, Henley in view of Stewart fails to teach the thickness of the ion depletion region, that is parallel to surface of the semiconductor and glass materials and the relationship between the alkali/alkaline earth ion concentrations (claim 130 and 131), thickness of the oxygen enhanced region (claim 132) and the thickness of the bonded glass layer (claim 134).

However, it would have been obvious to one with ordinary skill in the art at the time of the invention to judiciously adjust and control these parameters during the creation of SOI wafers between silicon wafer and glass by the anodic bonding through routine experimentation and optimization to achieve optimum benefits (see MPEP 2144.05) and it would not yield any unexpected results. These parameters will depend on the particular semiconductor material, the glass used and the processing parameters such as time, temperature and voltage so that a final SOI wafer with adequate bond strength is produced satisfying the manufacturing goal.

Note that the specification contains no disclosure of either the critical nature of the claimed processes or any unexpected results arising therefrom. Where patentability is said to be based upon particular chosen methods or upon another variable recited in a claim, the Applicant must show that the chosen methods or variables are critical (*Woodruff*, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir., 1990)). See also *In re Aller, Lacey and Hall* (10 USPQ 233 – 237).

Regarding claim 136, limitations of the claim have been described earlier in rejecting claim 97.

5. Claims 103 and 135 are rejected under 35 U.S.C. 103(a) as being unpatentable over Henley, US 6,010,579 in view of Stewart, US 6,610,582; Spangler, US 5,343,064; Walker, US 6,825,909 and "Resistivity of Glass", http://hypertextbook.com/facts/2004/JaneGolubovskaya.shtml. as applied to claim 97 above, and further in view of Cho, US 2004/0020173.

Regarding claim 103, Henley in view of Stewart, Spangler and Walker fails to teach bond strength between material S and material G is at least 8 joules/meter^2.

Cho teaches that anodic bonding between glass and a semiconductor material can produce bond strength that is higher than the fracture strength of the glass materials that is inherently higher than 8 joules/meter^2 for the benefit of making it a high – yield process in paragraphs 9 and 53.

Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention to modify Henley in view of Stewart with that of Cho so that bond strength that is higher than the fracture strength of the glass materials for the benefit of making it a high – yield process as taught by Cho in paragraphs 9 and 53.

Regarding claim 135, the limitations of the claim have been described earlier in rejecting claims 97 and 103.

Regarding claim 136, the limitations of the claim have been described earlier in rejecting claims 97 and 111.

Response to Arguments

6. Applicant's arguments filed May 22, 2006 have been fully considered but they are not persuasive due to the following reasons. The Applicant's arguments can be divided into two parts.

The first part of the Applicant's argument is regarding newly amended claim 97 and claim 111 in between paragraph 3, page 17 and paragraph 2, page 19. The claim can be simply redefined as follows. The Applicant is claiming a SOI structure by anodically bonding an oxide glass with an exfoliated semiconductor material wherein

the interface has several layers due to the migration of positive ions and oxygen and wherein the oxide glass has a certain CTE, resistivity and strain point. The Applicant's argument regarding the claim is that although the "Examiner has found some teachings in the prior art, he has not established that one skilled in the art would be lead to combine them in the way that is claimed. Instead, it is believed that the Examiner has used Applicant's disclosure as the blueprint to pick and choose snippets of disclosure from **five references** to patch together an argument that claim 97 is obvious" (last paragraph in page 18). This argument is not persuasive.

In response to applicant's argument that there is no suggestion to combine the references, the Examiner recognizes that obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art. See *In re Fine*, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988) and *In re Jones*, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

Furthermore, in response to applicant's argument that the examiner has combined an excessive number of references, reliance on a large number of references in a rejection does not, without more, weigh against the obviousness of the claimed invention and does not have a bearing on the propriety of the rejection; theoretically such could be infinite. See *In re Gorman*, 933 F.2d 982, 18 USPQ2d 1885 (Fed. Cir. 1991); *Ex parte Fine*, 1927 C. D. 84 (1926).

In this case, Claim 97 was rejected by Examiner as being obvious over a

combination of five references namely, Henley, Stewart, Spangler, Walker and JaneGolubovskaya. It is noteworthy that the Applicant has not objected to the teachings of the Henley and Stewart references and the strain point of the glass. Henley and Stewart teach that a SOI structure can be formed by anodically bonding an oxide glass with an exfoliated semiconductor material wherein the interface has several layers due to the migration of positive ions and oxygen. They teach that to anodically bond the glass to the silicon, the glass needs to have some positive ions (such as alkali ions like sodium, potassium, lithium, etc) and oxygen so that they can migrate due to the application of high voltage to the glass/silicon pair.

Therefore, based on the teachings of Henley and Stewart, it would have been obvious to one with ordinary skill in the art at the time of the invention to use a glass that has oxygen and positive ions. In other words, the glass will be an oxide glass and will contain positive alkali ions such as sodium, potassium, lithium, etc. By the same token, it would have been also obvious to one with ordinary skill in the art at the time of the invention to use an oxide glass containing alkali earth ions such as calcium and magnesium since they are network modifiers of glass structures and will be able to migrate under the influence of the voltage across the glass/silicon pair and therefore suitable for anodic bonding.

Stewart teaches glass such as pyrex glass (column 4, line 66) and when these glasses are bonded to silicon, will develop thermal stress due to the difference in the thermal expansion between them (column 1, lines 43 – 55) since bonding operation is carried out at a temperature between 200 – 500^{O}C (column 1, line 33). Thus, it would

have been obvious to one with ordinary skill in the art at the time of the invention that the thermal expansion of the glass and the silicon should be close to each other to minimize the thermal stress. Additionally, it would have been obvious to one with ordinary skill in the art at the time of the invention that since the bonding process is actuated by the migration of charged ions due to the application of a field (column 1, line 34) the resistivity of the glass will also have a role in the bonding process. However Stewart does not teach the resisitivity and the thermal expansion values of the glass. <u>However, Stewart teaches the use of pyrex glass (Corning 7740), which inherently meets the thermal expansion, resisitivity and strain point limitations of claim 97</u>.

Spangler teaches anodic bonding of silicon semiconductor devices with borosilicate glass (column 3, lines 60 – 67) and the use of Corning 1729 and Corning 7740 glasses (column 14, lines 67) and Corning 7070 glass (column 4, line 7) that has thermal expansion values close to that of monocrystalline silicon (column 4, lines 6 – 9). All these glasses are oxide glasses containing positive ions such as alkali and alkali earth ions and Corning 7740 glass is also known as Pyrex glass that was taught by Steweart to be a suitable for anodic bonding to silicon (see previous paragraph).

Walker teaches Corning 1737 glass with a 0 – 300^{O}C CTE of 37.6 X 10^{-7} /^{O}C and is close to that of silicon in column 4, lines 60 – 64. Corning 1737 glass is a low alkali containing borosilicate glass with a CTE close to that of silicon and therefore it would have been obvious to one with ordinary skill in the art at the time of the invention that this glass is similar to the glass taught by Stewart and will therefore be suitable for anodic bonding to silicon. It would have been obvious to one with ordinary skill in the

art at the time of the invention that all these glasses will have 0 – 300°C CTE of close to 38 X 10^{-7} /°C and will satisfy the relationship 5 X 10^{-7}/°C <= CTE <= 75 X 10^{-7}/°C .

It should be noted that the CTE range in the relationship is extremely wide (5 – 75) and it would have been obvious to one with ordinary skill in the art at the time of the invention that many borosilicate and other glasses will satisfy this relationship. Similarly, It would have been obvious to one with ordinary skill in the art at the time of the invention that all glasses cited by Stewart, Spangler and Walker will also satisfy the relationship cited in claim 111, namely CTE_1 – 20 X 10^{-7}/oC <= CTE_2 <= CTE_1 + 20 X 10^{-7}/oC where CTE_1 is the 0°C coefficient of thermal expansion of a single crystal semiconductor material and CTE_2 is the 0 – 300°C coefficient of thermal expansion oxide glass or oxide glass-ceramic. The expansion range is +/- 20 with respect to that of silicon and therefore covers a wide range.

The final argument regarding the rejection of claim 97 is the resistivity of the glass that according to the limitation of the claim is < =10^{16} Ω – cm. The Examiner used a WEB reference (JaneGolubovskaya) to show that the electrical resistivity of many glasses (an insulator that can be used for bonding to silicon for **S**ilicon **O**n Insulator structure) is less than 10^{16} Ω – cm. Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention that the borosilicate glasses taught by Stewart, Spangler and Walker that can be used for anodic bonding with silicon will have resistivity < =10^{16} Ω – cm.

It therefore follows from the above – described discussion that the Applicant's argument regarding Examiner's use of a combination of five references as being nor obvious is not persuasive.

The second part of Applicant's argument is the bond strength of the anodically bonded glass/silicon pair being greater than 8 joules/m^2 with reference to claims 103 and 106 (see last three paragraphs). The Applicant has requested the Examiner to support his position with reference to the rejection using the reference of Cho.

Cho teaches that the silicon substrate anodically bonded to a glass develops a bond that is higher than that of the fracture strength of the glass. As described earlier, it was established that for anodic bonding it would have been obvious to one with ordinary skill in the art at the time of the invention to use a glass that has oxygen and positive ions. In other words, the glass will be an oxide glass and will contain positive alkali ions such as sodium, potassium, lithium, etc. Borosilicate and aluminosilicate glasses containing alkali/alkali earth cations will fall under this category and will be preferable for anodic bonding to silicon. Cho fails to teach the type of glass and do not provide bond strength values.

However, it would have been obvious to one with ordinary skill in the art at the time of the invention that anodically bonded silicon/borosilicate/ aluminosilicate glass pair will exceed the strength of the individual glass. Incidentally, the bond strength values are expressed as being measured by fracture toughness measurements on Chevron notched specimens. Mecholsky ("A Chevron – Notched Specimen for Fracture Toughness Measurements of Ceramic – Metal Interfaces," ASTM Special Technical

Publication, 1984, 855, p 324 – 36) teaches that alumino silicate glasses have inherently very high fracture toughness that is over 8 joules/m^2. Therefore, it would have been obvious to one with ordinary skill in the art at the time of the invention that silicon if anodically bonded with glasses taught by Mecholsky will inherently have a bond strength value greater than 8 joules/m^2.

Conclusion

7. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Francos, US 5,272,827 and Miyazaki, US 6,537,938 teach glasses that can be anodically bonded to silicon.

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Asok K. Sarkar whose telephone number is 571 272 1970. The examiner can normally be reached on Monday - Friday (8 AM- 5 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, William B. Baumeister can be reached on 571 272 1722. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

10. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Asok Kumar Sarkar

Asok K. Sarkar
July 20, 2006

Primary Examiner